

FOREST RESEARCH REPORT

NOVA SCOTIA DEPARTMENT OF NATURAL RESOURCES

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THE EFFICACY AND COST OF FOUR HERBICIDE PRODUCTS APPLIED USING SELECTIVE METHODS

Tim O'Brien and Bob Murray

INTRODUCTION

In a previously published report (NSDNR #58, 1995) the productivity of four selective herbicide application methods was compared. These methods included applying (i) Release[®] or Vision[®] to the foliage, (ii) Velpar[®]L³ to the ground, (iii) Weedone[®] or Release[®] directly on one side of the bark of the target competition or iv) Weedone[®] on both sides of the bark of the target competition.

Applications of Weedone[®] and Release[®] to the bark allow selective targeting and can be used during the late fall and winter, thereby expanding the traditional "application window" for vegetation control. The bark and ground methods have possible advantages when competition consists of taller sprouts that are difficult to reach using foliar applications from the ground.

This report completes the study and compares the relative costs and effectiveness of these products and treatments in controlling maple sprout competition.

METHODS

Four herbicide products were used in this study, Release[®], Vision[®], Weedone[®] and Velpar[®]L⁴. The products were applied using different methods, rates of concentration and carrier agents: diesel oil (D), mineral oil (M) and water (Table 1). Refer to FRR #58 for details of application methods used in this trial.

Five sites were chosen for this study (Figure 1, Table 2). Four of the five were clearcuts (Glencoe, Cameron Settlement, Big Marsh and Sucker Lake) with either predominantly red maple (*Acer rubrum* L.) or sugar maple (*Acer saccharum* Marsh) competition. The fifth site, Frog Lake, originated from a shelterwood treatment that had received a final cut in 1990. The main competition at this site was sugar maple. The sites were treated between 1992 and 1994; Glencoe in 1992, Big Marsh, Cameron Settlement and Frog Lake in 1993 and Sucker Lake in 1994 (Table 2).

At each site, 7 blocks were established of which 6 were treated and one was left untreated as a control. Treatments were randomly assigned to blocks. Not all treatments were performed at each site. Spraying was carried out using a back pack sprayer for the Stream-line, Foliar and Low Volume applications whereas, a Spot Gun was used for Ground applications.



Figure 1. Herbicide Trial Sites

Prior to and following spraying, the average height (H) and percentage of ground covered by maple clumps (C) were measured. Percent ground cover was determined by establishing 10, 1.8 metre radius plots in each block prior to spraying. The plots were established as close as possible to the centre of a maple clump. Ground cover was estimated by determining the percentage of the plot covered by the foliage of the sprouts. Height and ground cover were then combined to form a competition index:

where: $CI = H \times C$

CI = Competition Index

H = Average height (metres) of maple sprouts

C = Percentage of ground covered by the sprouts

The CI, height and percent cover were averaged over all plots treated with a given rate and method by site. The average CI was used to represent the effect of the treatment on maple sprouts.

1 Release[®] Trademark of DowElanco

2 Vision[®] Silvicultural Herbicide is a registered trademark of the Monsanto Company, USA.

3 Velpar[®]L. Registered trademark of Du Pont Canada Inc.

4 Weedone[®] Trademark of Rhone-Poulenc Nederland B.V.

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Table 1. A listing of products by method of application.

Product	Method ¹	Amount of Product	Carrier	Sites	Blocks Treated
Release [®]	Streamline	20%, 30%	Diesel & Mineral oil	5	12
	Foliar	3%, 5%	Water	4	5
Vision [®]	Foliar	2%, 3%, 5%	Water	4	5
Velpar [®] L	Ground	1.5, 2.5 ml	None	3	3
Weedone [®]	Low volume 1-side	100%	Pre-mixed solution	1	1
	Low volume 2-side	100%	Pre-mixed solution	3	3

¹ For a detailed description of application methods refer to FRR #58.

² 1.5 and 2.5 ml of undiluted product were applied per cm of stump diameter.

RESULTS & DISCUSSION

PRODUCT EFFICACY

The efficacy results of the four herbicide products tested in this study are discussed individually by product. Presented in Figures 2a, b and c is CI versus time by treatment for each site. In order to simplify the presentation of these results, only the two most promising treatments in terms of efficacy; Release[®] and Vision[®], are presented in Figure 2. A complete listing of Height, Percent Ground Cover and CI for all treatments are found in Appendix I.

Release[®]

Release[®] was equally effective at both the 20% and 30% concentrations when mixed with diesel or mineral oil and applied using the Streamline method (Figure 2a, b, c; Appendix I). Two year results at sites where both rates were applied (Big Marsh, Cameron Settlement) indicate competition was all but eliminated the first year following spraying and remained in check the second year (Figure 2a). Sugar Maple was effectively controlled for two years at Frog Lake with the 20% Release rate (Figure 2c). Three year results with Release at Glencoe (red maple) also showed good control. CI for the 30% rate dropped from a pretreatment level of 60.8 (1.5 m tall, 39.5% ground coverage) to 0.3 (0.3 m tall, 2.9% ground coverage) in year three.

Carrier agents used with Release[®] did not affect post treatment competition levels where diesel or mineral oil was applied in equal concentrations (Figure 2a,b,c).

Foliar treatments of Release[®] were only effective in reducing maple competition the first year after treatment. Resprouting was observed at each of the locations where two year assessments were performed (Big Marsh, Glencoe, Cameron Settlement) (Figure 2a,b). By year two, the CI on foliar treated blocks at Big Marsh averaged 30.7 compared to a CI of 1.2 for the 20% Streamline treatment (Appendix I). Similar results were also observed at Cameron Settlement (Figure 2a).

Vision[®]

At each of the four locations where Vision[®]-Foliar treatments were tested (Glencoe, Cameron Settlement, Big Marsh and Sucker Lake)

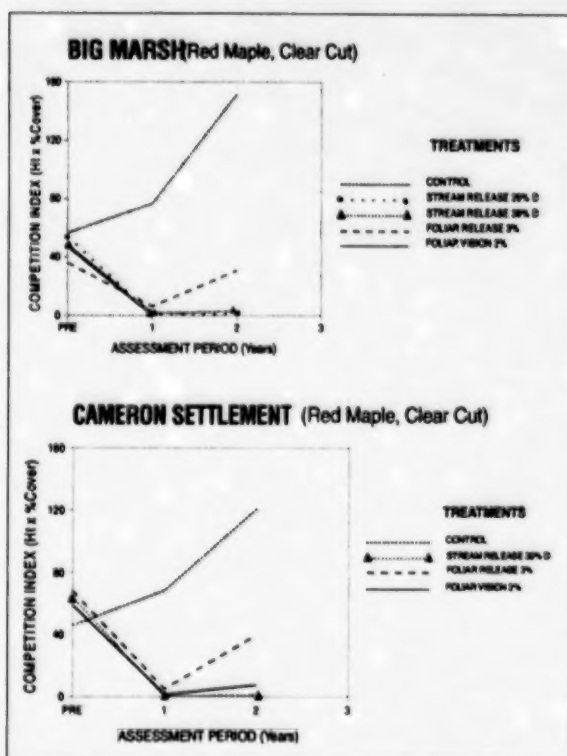


Figure 2a. Competition index by Assessment Period and treatment for Big Marsh and Cameron Settlement (only the most promising treatments in terms of efficacy and cost are presented).

competition levels were reduced the first year following treatment and remained in check for two years; three years at Glencoe (Figure 2a,b). For example, at Glencoe the CI for the 2% treatment had declined from 62.8 prior to treatment (1.4 m tall, 46% ground coverage) to 1.5 in year three (0.37 m tall and 4% ground coverage) compared to the untreated block which averaged 88.5 (1.67 m tall, 53% ground coverage).

Velpar[®]L

Competition control results with Velpar[®]L were mixed, as control varied depending on the site and the rate at which the chemical was applied. Excellent control was achieved in Glencoe at the 1.5 ml rate three years following treatment (0.3 m tall and 3.6% ground coverage; pretreatment CI=62.9) however, at Big Marsh with the same rate the results were poor; with resprouting occurring in the second year (CI=22.3; 1.7 m tall, 20.5% ground cover) (Appendix I).

At Cameron Settlement, the 2.5 ml Velpar[®]L rate achieved good control for two years after treatment. The CI in year two for 2.5 ml Velpar[®]L was 7.2 (0.7 m tall, covering 10% of the ground) compared to the CI for the control block in year two at 120.8 (2.3 m tall, covering 53% of the ground).

Weedone[®]

Control with Weedone[®] produced mixed results in this trial. Weedone achieved good control of sprouting for one year on all sites, however, vigorous resprouting occurred in the second year at two

Table 2. Pre-treatment site conditions by location.

Location	Previous Treatment	Date Harvested	Date Treated	Area Treated (ha)	Average Block Size (m)	Site Conditions				
						Dominant Species	Height of Sprouts (m)	Stems Clump ¹	Stumps Ha	Competition Index (CI) ²
Big Marsh	Clear Cut	1991	1993	1.2	0.20	Red Maple	1.44	33	1088	44.5
Cameron Settlement	Clear Cut	1991	1993	1.3	0.21	Red Maple	1.33	23	291	52.1
Glencoe	Clear Cut	1991	1992	1.7	0.34	Red Maple	1.44	10	1410	57.5
Sucker Lake	Clear Cut	1992	1994	1.1	0.18	Sugar Maple	1.58	14	383	32.0
Frog Lake	Shelterwood	1980-90 ³	1993	9.9	1.65	Sugar Maple	3.0-6.0 ⁴	10	890	ND ⁵

¹ On average each treated clump was made up of 2 stumps.

² The average Competition Index (CI) for the site prior to treatment. CI is determined by multiplying the height of the maple sprouts (m) by the percent ground cover (%).

³ The stand was harvested over a 10 year period with the final cut occurring in 1990.

⁴ Visual estimate.

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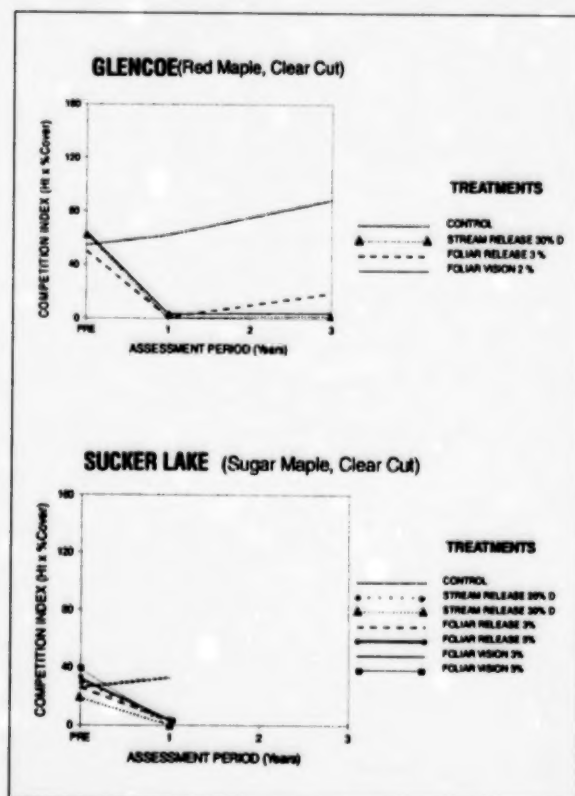


Figure 2b. Competition Index by Assessment Period and treatment for Glencoe and Sucker Lake (only the most promising treatments in terms of efficacy and cost are presented).

locations. Two year results at Cameron Settlement with the Low Volume 1-sided treatment indicate that Weedone® was unable to control maple sprouting at this site. Post-treatment (50.6) CI for Weedone® was higher than the pretreatment CI (45.2) in the second year (Appendix I).

In contrast, results at Glencoe with the Low Volume 2-Sided treatment indicated good control of maple sprouting. One year after treatment competition levels showed a sharp decline (CI=0.7; 0.5 m tall; 1.3% ground coverage) from the pretreatment CI of 53.5 and, by year three, the CI (17.6) was still low in comparison to the Control CI of 88.5 (Appendix I).

COSTS

Costs for each treatment-product combination tested in this trial are presented in Appendix II. The following should be considered in interpreting the results (1) non-productive time is approximately 10% and (2) extra care was used in applying the chemical to the target competition in order to minimize the volume of chemical used.

Predicted costs were directly related to the density of treated stumps per hectare. The two most promising treatments in terms of

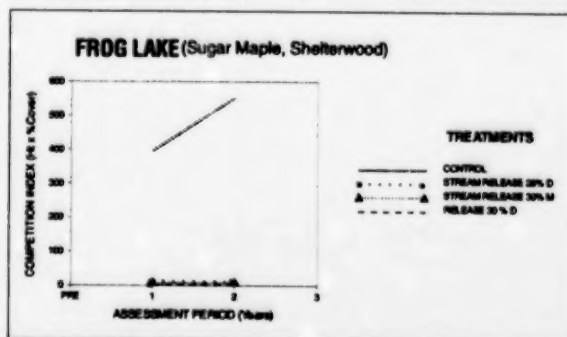


Figure 2c. Competition Index by Assessment Period and treatment for Frog Lake (only the most promising treatments in terms of efficacy and cost are presented).

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Carrier agents used with Release[®] did not affect post treatment competition levels where diesel or mineral oil was applied in equal concentrations (Figure 2a,b,c).

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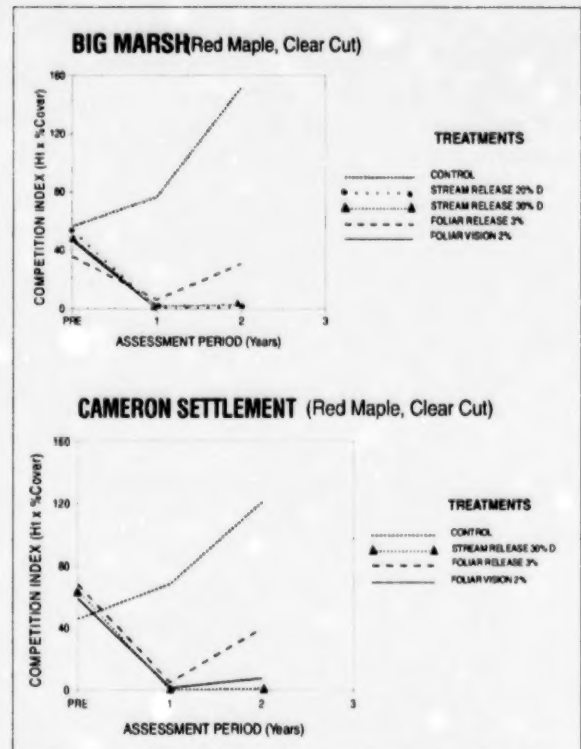


Figure 2a. Competition index by Assessment Period and treatment for Big Marsh and Cameron Settlement (only the most promising treatments in terms of efficacy and cost are presented).

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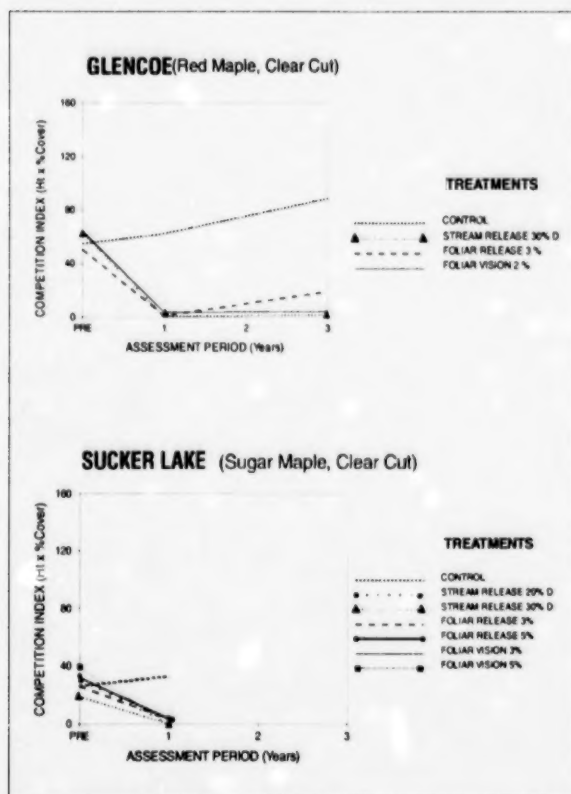


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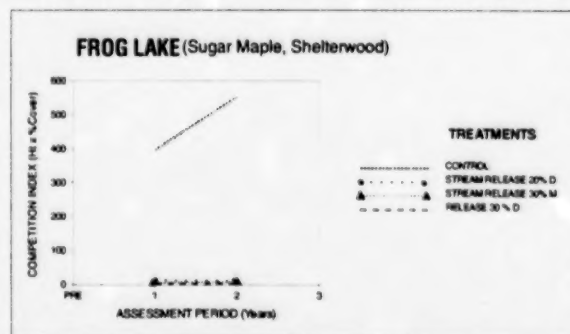


Figure 2c. Competition Index by Assessment Period and treatment for Frog Lake (only the most promising treatments in terms of efficacy and cost are presented).

efficacy and cost, Release® 20% diesel Streamline and Vision® 2%-Foliar, are discussed in detail.

Chemical Costs

Product costs (\$/litre) at 1995 prices are as follows: Release® \$22.23, Vision® \$14, Velpar®L \$19.75 and Weedone® \$13. Carrier agent prices were \$0.56/litre for diesel oil and \$1.35/litre for mineral oil.

The key factors in determining the chemical costs for each treatment were product price (\$/litre), rate of application (ml/stump) and carrier (diesel or mineral oil versus water). Release® was more expensive per litre, but even with lower chemical requirements per

stump 3.8 ml compared to 4.8 ml/stump for Vision®, resulted in higher chemical costs per treated stump. Release® costs per stump were 8.5 cents compared to 6.7 cents for Vision® (Appendix II).

Diesel oil used with Release® added approximately \$0.09/litre or 9.1% of the total chemical cost. No petroleum carriers were required for Vision®. Overall, Release® costs to treat 600 stumps/ha were \$16 more per ha compared to Vision® despite using less chemical per treated stump (Table 3).

Total treatment costs for the 20% Streamline Release® were \$11/ha lower than 2% Foliar®-Vision® treatments (\$107/ha for Release® versus \$118/ha for Vision®) at 600 stumps/ha.

Table 3. A comparison of total treatment costs¹ for the Streamline Release® 20% (diesel) and Foliar 2% Vision® treatments by density of treated stumps.

Density ² (stumps/ha)	Labour Costs ³ (\$/ha)			Chemical Costs ⁴ (\$/ha)			Total Treatment Costs ⁵ (\$/ha)		
	Release® 20% diesel ⁶	Vision® 2% ⁷	Difference (\$/ha)	Release® 20% diesel	Vision® 2%	Difference (\$/ha)	Release® 20% diesel	Vision® 2%	Difference (\$/ha)
200	34	51	-18	19	13	+5	52	65	-13
400	44	67	-23	37	27	+11	81	94	-13
600	51	78	-27	56	40	+16	107	118	-11
800	56	87	-31	75	53	+21	131	140	-9
1000	61	95	-33	93	67	+27	155	161	-7

¹ Treatment costs were determined by the Planning & Research Section and may not represent actual operating costs.

² On average each treated clump was made up of 2 stumps.

³ Predicted labour values are based on application technique and were derived in NSDNR #58 (1995). An hourly labour wage of \$15/hour was assumed.

⁴ Based on total chemical costs including carrier costs as shown in Appendix II.

⁵ Total Treatment Costs = Labour + Chemical Costs.

⁶ Release® applied at 20% concentration mixed with diesel oil.

⁷ Vision® applied at 2% concentration mixed with water.

MANAGEMENT RECOMMENDATION

Early results indicate Streamline applications of Release® (20% and 30% concentrations mixed with diesel or mineral oil) and Foliar applications of Vision® (2%) were effective in controlling red maple sprouts up to 2 years following treatment. Release® applications may be preferred if treatment during the late fall or winter is necessary or when the foliage of the competing trees is difficult to reach.

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APPENDIX I PRE AND POST TREATMENT SITE CONDITIONS BY LOCATION

LOCATION & HARVEST METHOD	TARGET SPECIES	TREATMENT	SPRAY DATE	BLOCK	PRODUCT	AMOUNT OF PRODUCT	MIX	ASSESSMENTS (years after treatment)											
								PRE			1			2			3		
								GrCv	HR	CI*	GrCv	HR	CI	GrCv	HR	CI	GrCv	HR	CI
Big Marsh (Clearcut)	Red Maple	Streamline 1-side	031193	7	Release ^a	20%	diesel	37.5	1.44	64.0	0.9	0.15	0.1	1.9	0.61	1.2			
		Streamline 1-side	031193	8	Release ^a	30%	diesel	33.6	1.40	48.9	0.8	0.24	0.2	3.0	0.42	1.3			
		Follar	130993	2	Vision ^a	2%	water	28.0	1.64	46.5	0.8	0.15	0.1	1.6	0.30	0.3			
		Follar	031193	3	Release ^a	3%	water	28.2	1.42	35.8	9.0	0.68	6.1	19.7	1.56	30.7			
		Low volume 2-side	031193	4	Weedone ^a	100%	NIL	29.0	1.43	41.5	12.7	0.91	11.6	22.6	1.82	38.5			
		Ground	260593	1	Velpar ^a	1.5 ml	NIL	23.1	1.33	30.7	18.0	1.24	22.3	20.6	1.73	35.5			
		CONTROL		6	-	-	-	39.0	1.48	58.8	44.5	1.72	76.5	57.0	2.86	151.6			
Cameron Settlement (Clearcut)	Red Maple	Streamline 1-side	081193	5	Release ^a	30%	diesel	38.0	1.89	64.2	1.0	0.16	0.2	2.7	0.33	0.9			
		Follar	120993	2	Vision ^a	2%	water	36.5	1.62	66.1	3.8	0.33	1.3	10.7	0.70	7.6			
		Follar	120993	3	Release ^a	3%	water	42.5	1.60	66.0	9.0	0.54	4.9	25.8	1.38	39.7			
		Low volume 1-side	081193	6	Weedone ^a	100%	NIL	29.0	1.66	46.2	12.0	1.42	17.0	30.1	1.68	50.6			
		Low volume 2-side	081193	4	Weedone ^a	100%	NIL	38.3	1.52	63.7	3.7	0.44	1.6	14.0	0.97	13.6			
		Ground	260593	1	Velpar ^a	2.5 ml	NIL	21.8	1.33	29.0	14.0	0.83	11.6	9.7	0.74	7.2			
		CONTROL		7	-	-	-	31.5	1.45	48.7	38.6	1.77	88.2	52.6	2.30	120.8			
Glencoe (Clearcut)	Red Maple	Streamline 1-side	031192	2	Release	30%	diesel	39.5	1.54	60.8	0.2	0.54	0.0				2.9	0.30	0.3
		Follar	160992	7	Vision	2%	water	48.5	1.38	62.8	1.1	0.25	0.0				4.0	0.37	1.6
		Follar	160992	5	Release	3%	water	34.0	1.48	60.3	3.1	0.26	0.8				17.6	1.06	18.7
		Low volume 2-side	031192	3	Weedone	100%	NIL	38.5	1.39	53.5	1.3	0.32	0.7				18.5	0.98	17.6
		Ground	160992	6	Velpar	1.5 ml	NIL	44.0	1.43	62.9	23.0	1.49	34.3				3.8	0.31	1.1
		CONTROL		4	-	-	-	39.0	1.40	64.5	42.0	1.48	82.2				53.0	1.67	88.5
		Streamline 1-side	031194	6	Release ^a	20%	diesel	18.9	1.67	31.6	0.1	0.05	0.0						
Sucker Lake (Clearcut)	Sugar Maple	Streamline 1-side	031194	5	Release ^a	20%	diesel	13.6	1.38	18.9	0.1	0.10	0.0						
		Follar	310994	1	Vision ^a	2%	water	27.5	1.86	51.2	4.2	0.52	2.2						
		Follar	070994	2	Release ^a	2%	water	18.9	1.37	25.9	6.8	0.50	3.3						
		Follar	310994	3	Vision ^a	5%	water	22.5	1.71	38.5	0.7	0.23	0.2						
		Follar	070994	4	Release ^a	5%	water	18.9	1.89	31.9	6.6	0.52	3.4						
		CONTROL		7	-	-	-	18.8	1.40	26.0	19.0	1.73	32.9						
		Streamline 1-side	221193	6	Release ^a	20%	diesel				3.8	1.54	4.9	6.5	0.68	4.9			
Frog Lake (Shelterwood)	Sugar Maple	Streamline 1-side	221193	7	Release ^a	20%	diesel				1.7	1.41	3.7	4.4	0.84	3.7			
		Streamline 1-side	221193	4	Release ^a	30%	diesel				0.1	0.53	0.1	0.7	0.19	0.1			
		Streamline 1-side	221193	6	Release ^a	30%	mineral				1.4	1.81	3.3	3.3	0.99	3.3			
		Streamline 1-side	221193	1	Release ^a	30%	diesel				0.9	0.69	0.6	2.8	0.76	2.1			
		Streamline 1-side	221193	2	Release ^a	30%	mineral				1.1	0.98	1.1	0.0	0.0	0.0			
		CONTROL		3	-	-	-				72.0	6.49	38.6	82.6	6.7	662.8			
		Streamline 1-side	221193	3	Release ^a	30%	mineral												

* Competition Index (CI) determined by multiplying the percentage of the ground covered by the sprouts (GrCv) by the average height (HT) of the stump sprouts

** No data collected (ND)

APPENDIX II ACTUAL & PREDICTED TREATMENT COSTS BY METHOD AND PRODUCT											
Method	Product ¹	Rate	Mix ²	Number of Blocks (#)	Stumps (#/ha)	Product Applied (ml/stump)	Costs				
							Chemical (cents/stump)		Labour ³ (cents/stump)	Total	
							Product	Mix		Actual (cents/stump)	Predicted ⁴ (\$/ha)
Streamline 1-Side	Release ¹	20%	Diesel Oil	4	826	3.80	8.49	0.85	9.34	7.5	16.84
		30%	Diesel Oil	6	898	5.82	13.01	0.76	13.77	7.3	21.07
		30%	Mineral Oil	2	920	6.74	15.06	2.12	17.18	7.0	24.18
Low Volume 1-side	Weedone ¹	-	Pre-mixed	1	274	25.00	32.50	0	32.50	14.0	46.50
Low Volume 2-side	Weedone ¹	-	Pre-mixed	3	731	42.12	54.80	0	54.80	15.3	70.10
Foliar	Release ¹	3%	Water	4	704	5.28	11.80	0	11.80	13.3	25.10
		5%	Water	1	419	7.16	16.00	0	16.00	11.0	27.00
	Vision ¹	2%	Water	3	864	4.77	6.68	0	6.68	13.3	19.98
		3%	Water	1	438	7.50	10.50	0	10.50	19.0	29.50
		5%	Water	1	377	13.26	18.56	0	18.56	18.0	36.56
Ground	Velpar ¹ L	1.5 ml	Undiluted	2	1571	12.28	24.25	0	24.25	7.0	31.25
		2.5 ml	Undiluted	1	181	29.17	57.61	0	57.61	19.0	76.61
¹ The 1995 chemical prices (\$/litre) used in this study are Release ² 22.35; Vision ² 14.00; Weedone ² 13.00; Velpar ² 19.75. ² The price of mixing agents was \$0.56 /litre for diesel oil and \$1.35/litre for mineral oil. ³ Labour costs were based on a wage rate of \$15/hour, and productivity of work performed by Planning and Research Staff. ⁴ Based on treating 600 stumps.											

APPENDIX I. PRE AND POST TREATMENT SITE CONDITIONS BY LOCATION

LOCATION & HARVEST METHOD	TARGET SPECIES	TREATMENT	SPRAY DATE	BLOCK	PRODUCT	AMOUNT OF PRODUCT	MIX	ASSESSMENTS (years after treatment)											
								PRE			1			2			3		
								GrCv	HR	Cf	GrCv	HR	CI	GrCv	HR	CI	GrCv	HR	CI
Big Marsh (Clearcut)	Red Maple	Streamline 1-side	031193	7	Release ¹	20%	diesel	37.5	1.44	54.0	0.9	0.15	0.1	1.9	0.61	1.2			
		Streamline 1-side	031193	6	Release ¹	30%	diesel	33.5	1.40	46.9	0.8	0.24	0.2	3.0	0.42	1.3			
		Follar	120993	2	Vision ¹	2%	water	28.0	1.64	45.9	0.6	0.15	0.1	1.6	0.20	0.3			
		Follar	031193	3	Release ¹	3%	water	25.2	1.42	35.8	8.0	0.68	6.1	19.7	1.56	30.7			
		Low volume 2-side	031193	4	Weedone ¹	100%	NIL	29.0	1.43	41.5	12.7	0.91	11.6	22.9	1.62	36.5			
		Ground	260593	1	Veipar ¹ L	1.5 ml	NIL	23.1	1.33	30.7	18.0	1.24	22.3	20.5	1.73	35.6			
		CONTROL		5				39.0	1.45	56.6	44.5	1.72	76.5	57.0	2.66	151.6			
Cameron Settlement (Clearcut)	Red Maple	Streamline 1-side	081193	5	Release ¹	30%	diesel	38.0	1.69	64.2	1.0	0.15	0.2	2.7	0.33	0.9			
		Follar	120993	2	Vision ¹	2%	water	36.5	1.62	59.1	3.8	0.33	1.3	10.7	0.70	7.5			
		Follar	120993	3	Release ¹	3%	water	42.5	1.60	68.0	9.0	0.54	4.9	28.8	1.38	39.7			
		Low volume 1-side	081193	6	Weedone ¹	100%	NIL	29.0	1.56	46.2	12.0	1.42	17.0	30.1	1.68	50.8			
		Low volume 2-side	081193	4	Weedone ¹	100%	NIL	35.3	1.52	53.7	3.7	0.44	1.6	14.0	0.97	13.6			
		Ground	260593	1	Veipar ¹ L	2.5 ml	NIL	21.8	1.33	29.0	14.0	0.83	11.6	8.7	0.74	7.2			
		CONTROL		7				31.5	1.45	45.7	36.5	1.77	68.2	52.5	2.30	120.8			
Glencoe (Clearcut)	Red Maple	Streamline 1-side	031192	2	Release	30%	diesel	39.5	1.54	60.8	0.2	0.04	0.0				2.9	0.30	0.3
		Follar	160992	7	Vision	2%	water	45.5	1.38	62.8	1.1	0.25	0.0				4.0	0.37	1.6
		Follar	160992	6	Release	3%	water	34.0	1.48	50.3	3.1	0.25	0.8				17.8	1.05	18.7
		Low volume 2-side	031192	3	Weedone	100%	NIL	38.5	1.39	53.5	1.3	0.52	0.7				18.6	0.95	17.6
		Ground	160992	5	Veipar	1.5 ml	NIL	44.0	1.43	62.9	23.0	1.19	34.3				3.6	0.31	1.1
		CONTROL		4				39.0	1.40	54.6	42.0	1.48	62.2				53.0	1.67	88.6
		Streamline 1-side	031194	6	Release ¹	20%	diesel	16.9	1.67	31.6	0.1	0.05	0.0						
Sucker Lake (Clearcut)	Sugar Maple	Streamline 1-side	031194	5	Release ¹	20%	diesel	13.6	1.39	18.9	0.1	0.10	0.0						
		Follar	310894	1	Vision ¹	3%	water	27.5	1.86	51.2	4.2	0.52	2.2						
		Follar	070994	2	Release ¹	3%	water	18.9	1.37	25.9	6.5	0.50	3.3						
		Follar	310894	3	Vision ¹ L	5%	water	22.5	1.71	38.5	0.7	0.23	0.2						
		Follar	070994	4	Release ¹	5%	water	16.9	1.69	31.9	6.6	0.52	3.4						
		CONTROL		7				18.6	1.40	26.0	19.0	1.73	32.9						
		Streamline 1-side	221193	5	Release ¹	20%	diesel												
Frog Lake (Shelterwood)	Sugar Maple	Streamline 1-side	221193	7	Release ¹	20%	diesel	3.8	1.94	4.9	3.8	1.94	4.9	8.5	0.58	4.9			
		Streamline 1-side	221193	4	Release ¹	30%	diesel	1.7	1.41	3.7	1.7	1.41	3.7	4.4	0.84	3.7			
		Streamline 1-side	221193	6	Release ¹	30%	mineral	0.1	0.03	0.1	0.1	0.03	0.1	0.7	0.19	0.1			
		Streamline 1-side	221193	1	Release ¹	30%	diesel	1.4	1.81	3.3	1.4	1.81	3.3	3.3	0.99	3.3			
		Streamline 1-side	221193	2	Release ¹	30%	mineral	0.9	0.69	0.6	0.9	0.69	0.6	2.8	0.75	2.1			
		CONTROL		3				1.1	0.98	1.1	1.1	0.98	1.1	0.0	0.0	0.0			
								72.0	5.49	39.5				82.5	6.7	552.8			

¹ Competition Index (CI) determined by multiplying the percentage of the ground covered by the sprouts (GrCv) by the average height (HT) of the stump sprouts

² No data collected (ND)

APPENDIX II
ACTUAL & PREDICTED TREATMENT COSTS BY METHOD AND PRODUCT

Method	Product ¹	Rate	Mix ²	Number of Blocks (#)	Stumps (#/ha)	Product Applied (ml/stump)	Costs					
							Chemical (cents/tstump)			Labour ³ (cents/stump)	Total	
							Product	Mix	Total		Actual (cents/stump)	Predicted ⁴ (\$/ha)
Streamline 1-Side	Release ^a	20%	Diesel Oil	4	826	3.80	8.49	0.85	9.34	7.5	16.84	101
		30%	Diesel Oil	6	898	5.82	13.01	0.76	13.77	7.3	21.07	126
		30%	Mineral Oil	2	920	6.74	15.06	2.12	17.18	7.0	24.18	145
Low Volume 1-side	Weedone ^a	-	Pre-mixed	1	274	25.00	32.50	0	32.50	14.0	46.50	279
Low Volume 2-side	Weedone ^a	-	Pre-mixed	3	731	42.12	54.80	0	54.80	15.3	70.10	421
Foliar	Release ^a	3%	Water	4	704	5.28	11.80	0	11.80	13.3	25.10	151
		5%	Water	1	419	7.16	16.00	0	16.00	11.0	27.00	162
	Vision ^a	2%	Water	3	864	4.77	6.68	0	6.68	13.3	19.98	120
		3%	Water	1	438	7.50	10.50	0	10.50	19.0	29.50	177
		5%	Water	1	377	13.26	18.56	0	18.56	18.0	36.56	219
Ground	Velpar ^a L	1.5 ml	Undiluted	2	1571	12.28	24.25	0	24.25	7.0	31.25	188
		2.5 ml	Undiluted	1	181	29.17	57.61	0	57.61	19.0	76.61	460

¹ The 1995 chemical prices (\$/litre) used in this study are Release^a 22.35; Vision^a 14.00; Weedone^a 13.00; Velpar^aL 19.75.

² The price of mixing agents was \$0.56 /litre for diesel oil and \$1.35/litre for mineral oil.

³ Labour costs were based on a wage rate of \$15/hour, and productivity of work performed by Planning and Research Staff.

⁴ Based on treating 600 stumps.